# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-102582
(43)Date of publication of application : 23.04.1993

(51)Int.Cl. H01S 3/10
G02F 1/35
H01S 3/07

(21)Application number : 03-264136
(22)Date of filing : 11.10.1991

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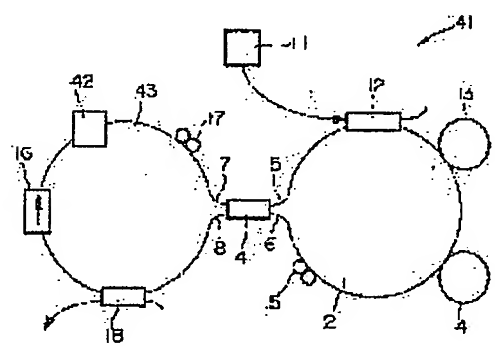
## (54) OPTICAL FIBER LASER DEVICE

(57)Abstract:
PURPOSE: To stabilize the repeating frequency of emitted ultrashort pulse beams by a method wherein a first optical fiber loop and a second optical fiber loop are coupled with each other and then a light modulating means is inserted into the second optical fiber so as to set up the modulation frequency in the value at the integer times of a resonator length.
CONSTITUTION: The title optical fiber laser device 41 is composed of a second optical fiber loop 43 wherein a rapid light modulator (light modulating means) is inserted between an optical isolator 16 of a second optical fiber loop 3 of a passive mode synchronous rare earth doped optical film laser 1 and a polarization controller 17. The rapid light modulator 42 is inserted into the optical fiber laser device 41 so as to make the repeating frequency of femto second optical pulse beams constant. The amplified medium corresponding to the wave length is actualized by the various rare earth doped optical fiber 13 and an exciting light source 11 exciting the same. The repeating frequency of the emitted ultrashort pulse beams will be augmented up to the integer times of repetition decided by the length of a resonator to be stabilized thereby.




LEGAL STATUS
[Date of request for examination] 18.05.1995
[Date of sending the examiner's decision of rejection]

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|---|---|
| [Kind of final disposal of application other than the examiner's decision of rejection or application converted registration] | |
| [Date of final disposal for application] | |
| [Patent number] | 2678176 |
| [Date of registration] | 01.08.1997 |
| [Number of appeal against examiner's decision of rejection] | |
| [Date of requesting appeal against examiner's decision of rejection] | |
| [Date of extinction of right] | |

CLAIMS

[Claim(s)]
[Claim 1] It consists of optical coupling means to combine the 1st optical fiber loop formation, the 2nd optical fiber loop formation, and said 1st optical fiber loop formation and the 2nd optical fiber loop formation. Said 1st optical fiber loop formation The light source for excitation, An optical multiplexing means to multiplex the light outputted from this light source for excitation, and a rare earth dope optical fiber, It has an optical fiber for an optical soliton switch, and the 1st polarization control means. Said 2nd optical fiber loop formation Optical fiber laser equipment characterized by coming to insert a light modulation means in said 2nd optical fiber loop formation in the optical fiber laser equipment which comes to have the direction control means of light which controls the travelling direction of light, the 2nd polarization control means, and the optical branching means which takes out light.
[Claim 2] Optical fiber laser equipment characterized by coming to set the modulation frequency of said light modulation means as the integral multiple of the cavity length of said optical fiber laser equipment in optical fiber laser equipment according to claim 1.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is used for generating of ultrashort light pulses, such as a femtosecond light pulse, and relates to suitable optical fiber laser equipment.
[0002]
[Description of the Prior Art] Recently, generating of ultrashort light pulses, such as a femtosecond light pulse using optical fiber laser, is studied briskly. Since the passive-mode-locking rare earth dope optical fiber laser by the loop-formation mirror which used the self-phase modulation effectiveness (SPM) which is one of the nonlinear optical effects of an optical fiber especially has the outstanding description that an ultrashort light pulse can be generated easily, research is made positively.
[0003] Drawing 3 is the block diagram showing the passive-mode-locking rare earth dope optical fiber laser 1.
[0004] this passive-mode-locking rare earth dope optical fiber laser 1 -- the 1st optical fiber loop formation 2 and the 2nd optical fiber loop formation 3 -- this -- it consists of 3dB couplers (optical coupling means) 4 which combine the 1st optical fiber loop formation 2 and the 2nd optical fiber loop formation 3.
[0005] The coupler 12 which multiplexs the light to which the 1st optical fiber loop formation 2 was outputted from the light source 11 for excitation, and this light source 11 for excitation (optical multiplexing means), It consists of a rare earth dope optical fiber 13, an optical fiber 14 for an optical soliton switch, and a polarization controller (1st polarization control means) 15. The 2nd optical fiber loop formation 3 It consists of an optical isolator (the direction control means of light) 16 which controls the travelling direction of light, a polarization controller (2nd polarization control means) 17, and a coupler (optical branching means) 18 which takes out light.
[0006] 3dB coupler 4 is equipped with two or more close outgoing radiation ports 5-8, the branching ratio of these close outgoing radiation ports 5-8 is the thing of 1:1, and the optical

mixer a waveguide mold star coupler and whose numbers of ports are three or more directional couplers is suitably used in addition to the above. The light source 11 for excitation excites the rare earth dope optical fiber 13, and semiconductor laser is used suitably.

[0007] Although couplers 12 and 18 are optical fiber star couplers, a waveguide mold star coupler, a directional coupler, etc. are suitably used in addition to these that these couplers 12 and 18 should just be what can multiplex or branch light.

[0008] The optical fiber 14 for an optical soliton switch can generate an optical soliton regularly, and a zero distribution shift optical fiber is used suitably. The polarization controllers 15 and 17 are for doubling the polarization of the light which turns around the 1st optical fiber loop formation 2, and the light which turns around the 2nd optical fiber loop formation 3.

[0009] The 1st optical fiber loop formation 2 is called the alias name nonlinear amplification loop mirror, and deforms the nonlinear optics loop-formation mirror described below.

[0010] Here, a nonlinear optics loop-formation mirror is explained. Drawing 4 is the block diagram showing the nonlinear optics loop-formation mirror 21. two ports 24 and 25 where the branching ratios of a coupler (optical coupling means) 23 differ the edges 22a and 22b of the optical fiber 22 with which this nonlinear optics loop-formation mirror 21 was bent in the shape of a loop formation -- it is alike, respectively and joins.

[0011] By this nonlinear optics loop-formation mirror 21, the light L0 which carried out incidence to the coupler 23 from input port 26 is divided into the light L1 which outgoing radiation is carried out from a port 24, and turns around a loop formation clockwise, and the light L2 which outgoing radiation is carried out from a port 25, and turns around a loop formation counterclockwise.

[0012] Since the self-phase modulation effectiveness (SPM) which is one of the 3rd nonlinear optical effects does not happen into an optical fiber 22 when the reinforcement of the light L0 which carries out incidence to a coupler 23 is weak, phase contrast is not produced between the light L1 which turns around a loop formation clockwise, and the light L2 which turns around a loop formation counterclockwise. Therefore, since the nonlinear optics loop-formation mirror 21 will act in a linearity field, the luminous intensity which appears in a port 27 serves as a value proportional to incidence reinforcement, and the proportionality constant will be determined by the branching ratio of a coupler 23.

[0013] That is, when luminous intensity which sets to alpha:1-alpha the branching ratio which is a coupler 23, and carries out incidence to a coupler 23 is set to I0, it is, Luminous-intensity I which appears in a port 27 is expressed with the following formula.

I=(4alpha2-4alpha+1) I0 -- (1)

Therefore, as a coupler 23, by the case where a branching ratio uses the 3dB coupler of 1:1, since alpha is set to 0.5, it is set to I= 0 from (1) type.

[0014] In being so strong that the reinforcement of the light L0 which carries out incidence to a coupler 23 generates the self-phase modulation effectiveness (SMP) in an optical fiber 22 on the other hand, phase contrast arises between the light L1 which turns around a loop formation clockwise, and the light L2 which turns around a loop formation counterclockwise. Consequently, the reinforcement of the light L3 which appears in a port 27 becomes large compared with the case where the self-phase modulation effectiveness (SMP) does not happen, and will increase nonlinearly to incidence reinforcement.

[0015] In this case, the reinforcement I of the light L3 switched to a port 27 is expressed with the following formula.

I=I0 (2alpha2-2alpha+1)

+ 2I0 and alpha(alpha-1) COS {2pin2 and L(1-2alpha) I0/lambda} -- (2)
However, n2 is [ the die length of an optical fiber 22 and lambda of a nonlinear refractive index and L ] the wavelength of incident light L0.
[0016] It is because the light L0 by which incidence is carried out from a port 26 in a linearity field when the optical reinforcement of light L0 is weak is hardly switched to a port 27, but the reason the nonlinear optics loop-formation mirror 21 is suitable for ultrashort light pulse generating will be switched if incidence reinforcement becomes strong. Therefore, if the nonlinear optics loop-formation mirror 21 is included in the resonator of laser, it is possible to operate as a ultra high-speed saturable absorber.
[0017] Next, the nonlinear amplification loop mirror which deformed the above-mentioned nonlinear optics loop-formation mirror 21 is explained based on drawing 5 . The points that this nonlinear amplification loop mirror 31 differs from the nonlinear optics loop-formation mirror 21 are the point that the magnification medium 32 which consists of a rare earth dope optical fiber etc. is located near the end of an optical fiber 22, and a point using 3dB coupler 33, with which a branching ratio is correctly set to 1:1 as a coupler 23.
[0018] Since the self-phase modulation effectiveness (SMP) does not happen in the optical fiber 22 within a loop formation even if the magnification medium 32 is joined when the reinforcement of the light L0 which carries out incidence to 3dB coupler 33 is weak, phase contrast is not produced between the light L1 which turns around a loop formation clockwise, and the light L2 which turns to a counterclockwise rotation. Therefore, when the reinforcement of the light L0 which carries out incidence is weak, the nonlinear amplification loop mirror 31 will act in a linearity field, and the light of most which turned around the loop formation will be returned to a port 26, and is hardly switched to a port 27.
[0019] On the other hand, since the magnification medium 32 is located near the end of a loop formation when the reinforcement of the light L0 which carries out incidence to 3dB coupler 33 is strong, the light L1 which turns around a loop formation clockwise will be amplified by the magnification medium 32 rather than the light L2 which turns counterclockwise, and optical reinforcement becomes strong. Therefore, phase contrast will arise between the light L1 which the self-phase modulation effectiveness (SMP) happens and turns around a loop formation clockwise into an optical fiber 22, and the light L2 which turns to a counterclockwise rotation, and the light L0 which carried out incidence from the port 26 is switched to a port 27.
[0020] Phase contrast deltaphi of such two light L1 and L2 is given by the following formula.
delta phi=deltaphiC-deltaphiCC=pi I0, n2, L (g-1)/lambda -- (3)
However, for the amount of phase changes of the light L1 to which deltaphiC turns around a loop formation clockwise, the amount of phase changes of the light L2 to which deltaphiCC turns around a loop formation counterclockwise, the reinforcement of the light L0 which carries out incidence of I0 to 3dB coupler 33, and n2, a nonlinear refractive index and L are [ gain and lambda of the die length of an optical fiber 22 and g ] the wavelength of incident light L0.
[0021] (3) If phase contrast deltaphi becomes large and this phase contrast deltaphi is set to pi, the greatest switching will take place, so that die-length L of an optical fiber 22 is so long that Gain g is large, as shown in a formula.
[0022] This nonlinear amplification loop mirror 31 has the description in the point which can switch a light pulse, even when the reinforcement of the light L0 which carries out incidence to 3dB coupler 33 compared with the nonlinear optics loop-formation mirror 21 mentioned above is comparatively weak.
[0023] Another optical fiber [ which was explained above ] loop formation (2nd optical fiber

loop formation 3) with which the passive-mode-locking rare earth dope optical fiber laser 1 inserted the optical isolator 16 in the nonlinear amplification loop mirror 31 like is connected. Therefore, mode locking can start according to the completely same operation and effectiveness as the nonlinear amplification loop mirror 31, and an ultrashort light pulse can be generated.

[0024]

[Problem(s) to be Solved by the Invention] However, by the conventional passive-mode-locking rare earth dope optical fiber laser 1, there was a fault that the repeat synchronization of a light pulse can become random as shown in drawing 6 , this repeat actuation could not be controlled, therefore the light pulse of stability and a high repeat frequency could not be generated since there is no equipment which controls the repeat of a light pulse.

[0025] Although the optical fiber laser which can generate a simple ultrashort light pulse is easily realizable in the present condition, generating of the high-speed light pulse train it was decided that a repeat frequency would be is very difficult.

[0026] This invention is to be made in view of the above-mentioned situation, and offer the optical fiber laser equipment which can control the optical reinforcement of an ultrashort light pulse, and repeat actuation.

[0027]

[Means for Solving the Problem] In order to solve the above-mentioned technical problem, this invention adopted the following optical fiber laser equipments.

[0028] Namely, optical fiber laser equipment according to claim 1 It consists of optical coupling means to combine the 1st optical fiber loop formation, the 2nd optical fiber loop formation, and said 1st optical fiber loop formation and the 2nd optical fiber loop formation. Said 1st optical fiber loop formation The light source for excitation, An optical multiplexing means to multiplex the light outputted from this light source for excitation, and a rare earth dope optical fiber, It has an optical fiber for an optical soliton switch, and the 1st polarization control means. Said 2nd optical fiber loop formation In the optical fiber laser equipment which comes to have the direction control means of light which controls the travelling direction of light, the 2nd polarization control means, and the optical branching means which takes out light, it is characterized by coming to insert a light modulation means in said 2nd optical fiber loop formation.

[0029] Moreover, optical fiber laser equipment according to claim 2 is characterized by coming to set the modulation frequency of said light modulation means as the integral multiple of the cavity length of said optical fiber laser equipment in optical fiber laser equipment according to claim 1.

[0030]

[Function] With optical fiber laser equipment according to claim 1, by inserting a light modulation means in said 2nd optical fiber loop formation, repeat actuation of the ultrashort light pulse to generate is controlled, and the repeat frequency of this ultrashort light pulse is stabilized.

[0031] Moreover, with optical fiber laser equipment according to claim 2, by setting the modulation frequency of said light modulation means as the integral multiple of the cavity length of said optical fiber laser equipment, repeat actuation of the ultrashort light pulse to generate is controlled, and the repeat frequency of this ultrashort light pulse is raised even to the integral multiple of the repeat decided by the die length of the resonator of laser, and is stabilized.

[0032]

[Example] Hereafter, the optical fiber laser equipment of one example of this invention is explained based on drawing 1 .

[0033] This optical fiber laser equipment 41 inserts the high-speed optical modulator (light modulation means) 42 between the optical isolator 16 of the 2nd optical fiber loop formation 3 of the passive-mode-locking rare earth dope optical fiber laser 1 of the conventional example, and the polarization controller 17, makes it the 2nd optical fiber loop formation 43, attaches the same sign about the same component as said passive-mode-locking rare earth dope optical fiber laser 1, and omits explanation.
[0034] The high-speed optical modulator 42 modulates a light pulse at high speed, and the frequency which drives this high-speed optical modulator 42 is set as the integral multiple of the cavity length L of laser.
[0035] Next, actuation of this optical fiber laser equipment 41 is explained. It is multiplexed by the coupler 12 and the light outputted from the light source 11 for excitation excites the rare earth dope optical fiber 13.
[0036] When the luminous intensity which carries out incidence to the 1st optical fiber loop formation 2 is weak, light is not switched to a port 8 but returns to the same port 7 as input port 7. This light is removed by the optical isolator 16, in order to go the inside of the 2nd optical fiber loop formation 43 to hard flow with the forward direction of an optical isolator 16. On the other hand, when the luminous intensity which carries out incidence to the 1st optical fiber loop formation 2 is strong, light is switched to a port 8 and progresses the inside of the 2nd optical fiber loop formation 43 in the same direction as the forward direction of an optical isolator 16. Incidence of this light is again carried out to the 1st optical fiber loop formation 2 from a port 7, and it appears in a port 8 again. Mode locking will start by this switching and an ultrashort light pulse will occur. This ultrashort light pulse can be taken out outside with a coupler 18.
[0037] With this optical fiber laser equipment 41, by changing group-velocity distribution (Group Velocity Dispersion:GVD) of the optical fiber 14 for an optical soliton switch within the 1st optical fiber loop formation 2, the degree of waveform shaping can be changed and a shorter ultrashort light pulse can be generated according to the optical soliton effectiveness.
[0038] Here, an optical soliton is explained. An optical soliton is a stable ultrashort light pulse generated by the breadth of the pulse width by group-velocity distribution (GVD) of an optical fiber and compression of the pulse width by the self-phase modulation effectiveness (SPM) hanging, and suiting, and it has the description of spreading the inside of an optical fiber, without changing a wave. With said optical fiber laser equipment 41, by making negative group-velocity distribution (GVD) of the optical fiber 14 for an optical soliton switch, an optical soliton is generated and the stable ultrashort light pulse in which pulse width does not spread can be obtained.
[0039] For example, the peak intensity P1 required to make the standard soliton of N= 1 is [Equation 1].

It is come out and given. Here, group-velocity distribution [ in / in D / the wavelength lambda of an optical fiber ] (GVD) and c are [ pulse width and w of the velocity of light and tau ] the magnitude of the spot size of an optical fiber. for example, peak intensity required to build the standard soliton of N= 1 when magnitude of 1.1ps(es) and spot size is set to 4 micrometers and wavelength is set [ group-velocity distribution (GVD) ] to 1.56 micrometers for -24 ps/km/nm and pulse width -- about 30 -- it is set to W. Since it can be made to generate easily within optical fiber laser equipment 41, peak intensity of this level can realize switching by the optical soliton.

[0040] In optical fiber laser equipment 41, in order that an optical soliton may spread the inside of a resonator, the energy per [ to generate ] light pulse serves as a fixed value. (4) A formula shows that energy PN=1 and tau per light pulse are proportional to |D|/tau. If absolute value |D| of group-velocity distribution (GVD) of the optical fiber 14 for an optical soliton switch is made small, it will move by the case where excitation reinforcement is fixed so that pulse width tau may become small and may make energy a fixed value inevitably. Therefore, if absolute value |D| of group-velocity distribution (GVD) is made small, a femtosecond light pulse can be generated.
[0041] Since the high-speed optical modulator 42 is inserted in optical fiber laser equipment 41, the repeat frequency of a femtosecond light pulse can be made regularity. moreover -- for example, -- if the optical fiber 14 for an optical soliton switch whose zero distribution wavelength is 1.3 micrometers is used -- wavelength -- 1.3 micrometers -- a long wave -- if it is merit, an ultrashort light pulse can be generated using the optical soliton effectiveness, and the light source 11 for excitation which excites the rare earth dope optical fiber 13 which doped various rare earth, and it can realize the magnification medium according to wavelength.
[0042] Drawing 2 shows the situation of the repeat of the ultrashort light pulse outputted by optical fiber laser equipment 41. It turns out that the repeat frequency of the ultrashort light pulse to generate is raised even to the integral multiple of the repeat decided by the die length of a resonator, and is stabilized from this drawing, and the repeat frequency of a light pulse is controlled good. Therefore, the ultrashort light pulse of stability and a high repeat frequency can be generated.
[0043] As explained above, according to the optical fiber laser equipment 41 of this example Since the frequency which inserts the high-speed optical modulator 42 between an optical isolator 16 and the polarization controller 17, considers as the 2nd optical fiber loop formation 43, and drives said high-speed optical modulator 42 was set as the integral multiple of the cavity length L of laser The repeat frequency of the ultrashort light pulse to generate can be raised even to the integral multiple of the repeat decided by the die length of the resonator of laser, and the repeat frequency of this ultrashort light pulse can be stabilized.
[0044]
[Effect of the Invention] As explained above, according to the optical fiber laser equipment of this invention according to claim 1 It consists of optical coupling means to combine the 1st optical fiber loop formation, the 2nd optical fiber loop formation, and said 1st optical fiber loop formation and the 2nd optical fiber loop formation. Said 1st optical fiber loop formation The light source for excitation, An optical multiplexing means to multiplex the light outputted from this light source for excitation, and a rare earth dope optical fiber, It has an optical fiber for an optical soliton switch, and the 1st polarization control means. Said 2nd optical fiber loop formation Since it carried out in the optical fiber laser equipment which comes to have the direction control means of light which controls the travelling direction of light, the 2nd polarization control means, and the optical branching means which takes out light to coming to insert a light modulation means in said 2nd optical fiber loop formation Repeat actuation of the ultrashort light pulse to generate can be controlled, and the repeat frequency of this ultrashort light pulse can be stabilized.
[0045] Moreover, since modulation frequency of said light modulation means was carried out in optical fiber laser equipment according to claim 1 to coming to set it as the integral multiple of the cavity length of said optical fiber laser equipment according to optical fiber laser equipment according to claim 2, repeat actuation of the ultrashort light pulse to generate is controllable, and

the repeat frequency of this ultrashort light pulse can be raised even to the integral multiple of the repeat decided by the die length of the resonator of laser, and can be stabilized.

[Translation done.]

## TECHNICAL FIELD

[Industrial Application] This invention is used for generating of ultrashort light pulses, such as a femtosecond light pulse, and relates to suitable optical fiber laser equipment.

## PRIOR ART

[Description of the Prior Art] Recently, generating of ultrashort light pulses, such as a femtosecond light pulse using optical fiber laser, is studied briskly. Since the passive-mode-locking rare earth dope optical fiber laser by the loop-formation mirror which used the self-phase modulation effectiveness (SPM) which is one of the nonlinear optical effects of an optical fiber especially has the outstanding description that an ultrashort light pulse can be generated easily, research is made positively.
[0003] Drawing 3 is the block diagram showing the passive-mode-locking rare earth dope optical fiber laser 1.
[0004] this passive-mode-locking rare earth dope optical fiber laser 1 -- the 1st optical fiber loop formation 2 and the 2nd optical fiber loop formation 3 -- this -- the 3dB coupler which combines the 1st optical fiber loop formation 2 and the 2nd optical fiber loop formation 3

## EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to the optical fiber laser equipment of this invention according to claim 1 It consists of optical coupling means to combine the 1st

optical fiber loop formation, the 2nd optical fiber loop formation, and said 1st optical fiber loop formation and the 2nd optical fiber loop formation. Said 1st optical fiber loop formation The light source for excitation, An optical multiplexing means to multiplex the light outputted from this light source for excitation, and a rare earth dope optical fiber, It has an optical fiber for an optical soliton switch, and the 1st polarization control means. Said 2nd optical fiber loop formation Since it carried out in the optical fiber laser equipment which comes to have the direction control means of light which controls the travelling direction of light, the 2nd polarization control means, and the optical branching means which takes out light to coming to insert a light modulation means in said 2nd optical fiber loop formation Repeat actuation of the ultrashort light pulse to generate can be controlled, and the repeat frequency of this ultrashort light pulse can be stabilized.

[0045] Moreover, since modulation frequency of said light modulation means was carried out in optical fiber laser equipment according to claim 1 to coming to set it as the integral multiple of the cavity length of said optical fiber laser equipment according to optical fiber laser equipment according to claim 2, repeat actuation of the ultrashort light pulse to generate is controllable, and the repeat frequency of this ultrashort light pulse can be raised even to the integral multiple of the repeat decided by the die length of the resonator of laser, and can be stabilized.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, by the conventional passive-mode-locking rare earth dope optical fiber laser 1, there was a fault that the repeat synchronization of a light pulse can become random as shown in drawing 6 , this repeat actuation could not be controlled, therefore the light pulse of stability and a high repeat frequency could not be generated since there is no equipment which controls the repeat of a light pulse.

[0025] Although the optical fiber laser which can generate a simple ultrashort light pulse is easily realizable in the present condition, generating of the high-speed light pulse train it was decided that a repeat frequency would be is very difficult.

[0026] This invention is to be made in view of the above-mentioned situation, and offer the optical fiber laser equipment which can control the optical reinforcement of an ultrashort light pulse, and repeat actuation.

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## MEANS

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(Optical coupling means) It consists of 4.

[0005] The 1st optical fiber loop formation 2 is a coupler which multiplexs the light outputted from the light source 11 for excitation, and this light source 11 for excitation.

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## OPERATION

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[Function] With optical fiber laser equipment according to claim 1, by inserting a light modulation means in said 2nd optical fiber loop formation, repeat actuation of the ultrashort light pulse to generate is controlled, and the repeat frequency of this ultrashort light pulse is stabilized.
[0031] Moreover, with optical fiber laser equipment according to claim 2, by setting the modulation frequency of said light modulation means as the integral multiple of the cavity length of said optical fiber laser equipment, repeat actuation of the ultrashort light pulse to generate is controlled, and the repeat frequency of this ultrashort light pulse is raised even to the integral multiple of the repeat decided by the die length of the resonator of laser, and is stabilized.

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## EXAMPLE

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[Example] Hereafter, the optical fiber laser equipment of one example of this invention is explained based on drawing 1 .
[0033] This optical fiber laser equipment 41 is a high-speed optical modulator between the optical isolator 16 of the 2nd optical fiber loop formation 3 of the passive-mode-locking rare earth dope optical fiber laser 1 of the conventional example, and the polarization controller 17.

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## DESCRIPTION OF DRAWINGS

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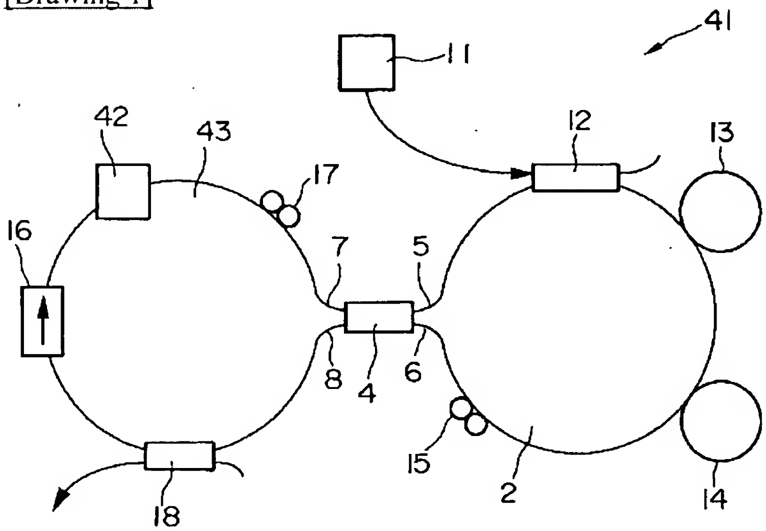
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the optical fiber laser equipment of this invention.
[Drawing 2] It is drawing showing the situation of the repeat of the ultrashort light pulse outputted from the optical fiber laser equipment of this invention.
[Drawing 3] It is the block diagram of conventional optical fiber laser equipment.
[Drawing 4] It is the block diagram of the conventional nonlinear optics loop-formation mirror.
[Drawing 5] It is the block diagram of the conventional nonlinear amplification loop mirror.
[Drawing 6] It is drawing showing the situation of the repeat of the ultrashort light pulse outputted from conventional optical fiber laser equipment.
[Description of Notations]
41 Optical Fiber Laser Equipment
2 1st Optical Fiber Loop Formation
4 3dB Coupler (Optical Coupling Means)
5-8 Port
11 Light Source for Excitation
12 Coupler (Optical Multiplexing Means)
13 Rare Earth Dope Optical Fiber
14 Optical Fiber for Optical Soliton Switch
15 Polarization Controller (1st Polarization Control Means)
16 Optical Isolator (the Direction Control Means of Light)
17 Polarization Controller (2nd Polarization Control Means)
18 Coupler (Optical Branching Means)
42 High-speed Optical Modulator (Light Modulation Means)
43 2nd Optical Fiber Loop Formation

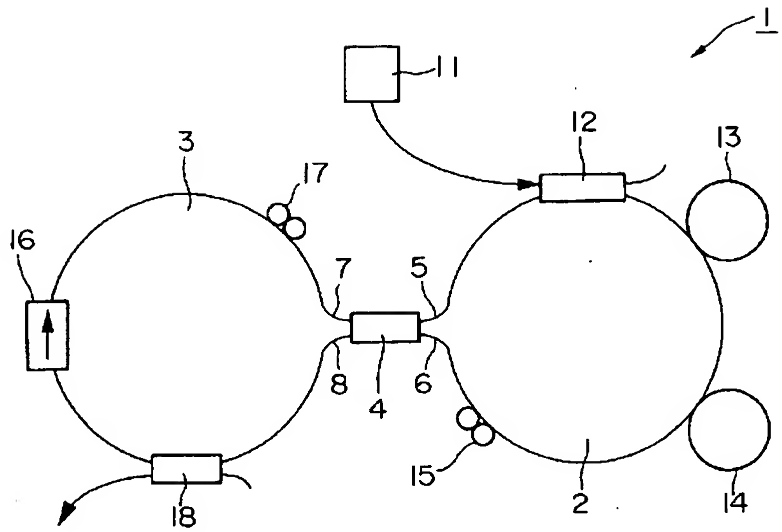
DRAWINGS

[Drawing 1]

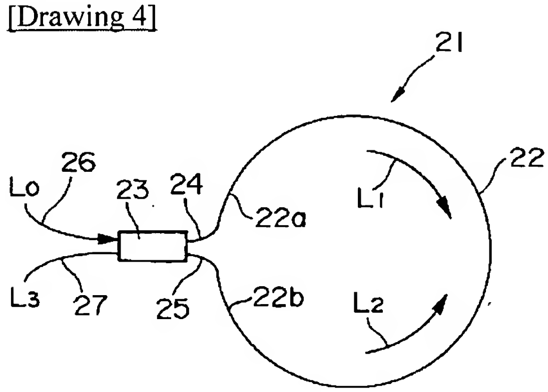



[Drawing 2]

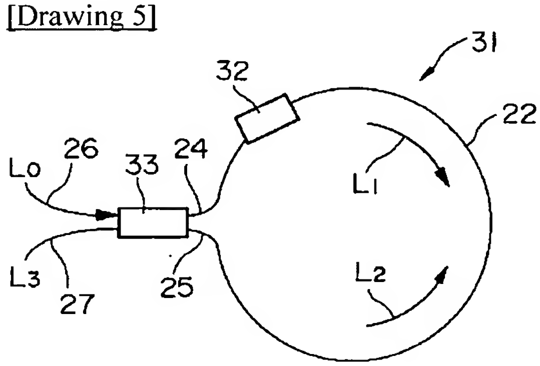

[Drawing 3]



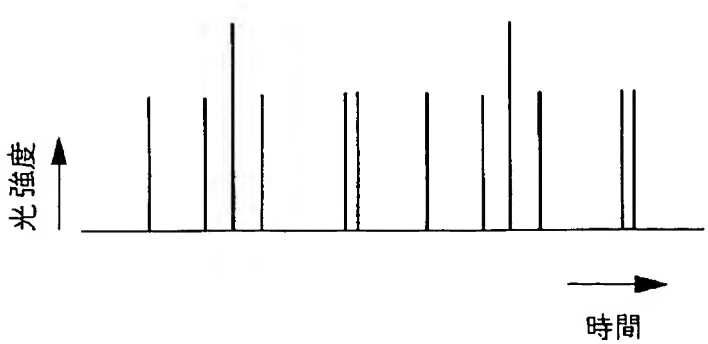

[Drawing 4]




[Drawing 5]




[Drawing 6]



光強度
時間